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ARTICLE

Association of oral health with body weight: a prospective study in community-dwelling older adults

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Abstract

Background To prevent involuntary weight loss in older people, the knowledge about factors affecting body weight (BW) is essential. Therefore, we aimed to investigate the longitudinal associations of multiple oral health aspects with BW in community-dwelling older adults.

Methods This analysis is based on prospective data with a 10-year follow-up of 657 Dutch community-dwelling older adults (age 66.4 ± 5.8 years, 54% female) from the Longitudinal Aging Study Amsterdam. Participants' characteristics, BW, and 12 oral health variables (teeth, dentures, nine oral problems, self-rated oral health) were assessed in 2005/07 and 2015/16. The association between oral health and BW was analyzed by mixed models and adjusted for demographic, socio-economic, smoking, health, and functional aspects considering data of both assessments.

Results Mean BW was 79.1 ± 13.3 kg at baseline (B) and 77.6 ± 13.8 kg at follow-up (FU). At baseline, 29.6% of the participants reported being edentulous (FU:34.4%) and 55.8% to wear dentures (FU:62.3%). Dental pain while chewing was the oral problem with the lowest (B:5.2%, FU:6.6%) and xerostomia with the highest prevalence at both examinations (B:24.3%, FU:30.0%). Most participants rated their oral status as healthy (B:65.2%, FU:66.9%). Neither edentulism and denture use nor oral problems showed a longitudinal association with BW. In contrast, self-rated oral health was associated with BW ($b = 0.724$, SE = 0.296, $p = 0.015$) after adjusting for multiple confounders.

Conclusions In community-dwelling older adults self-rated oral health may indicate changes in body weight in the long term. Therefore, this simple measure could serve to identify a risk for weight loss and to initiate oral interventions in clinical practice.

Introduction

Body weight is an important indicator of nutritional status. Correspondingly, involuntary weight loss is commonly used as criterion to identify malnutrition [1]. As involuntary weight loss in older age is related to functional decline and to mortality [2–4], the knowledge about factors affecting body weight is essential in order to develop preventive strategies.

One factor that is hypothesized to influence body weight in older people is the oral health status [5]. Oral health is complex, subsuming aspects such as teeth- and denture-related issues, oral pain, xerostomia, and gingival problems [6, 7] that may affect body weight by different pathways. Due to morbidity and unfavorable behaviors, e.g., poor oral hygiene or smoking, oral health deteriorates during aging and is often impaired in older adults [6, 8, 9]. Impaired dental status, e.g., missing, lose or broken teeth or dental caries, as well as ill-fitting dentures can impede masticatory function and may consequently result in an unbalanced diet not meeting energy and nutrient requirements [10–12]. Insufficient dietary intake is considered an important driver for weight loss [1]. Xerostomia, especially in combination with a reduced saliva flow, can negatively affect insalivation as well as taste and texture perception of the foods in the mouth [13], which may also lead to an insufficient

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dietary intake [14]. Further oral health problems, such as inflamed gums, gingivitis and sores in the mouth, are related to inflammatory processes that are known to contribute to wasting conditions [1]. Both teeth- and denture-related issues as well as gingival problems can cause pain while eating or drinking. A common strategy to cope with oral pain is avoidance behavior [15] i.e., to eat and drink less or to eliminate certain foods from the meal plan, which again can lead to insufficient dietary intake and weight loss.

There are plenty cross-sectional studies showing an association between oral health measures and nutritional status in older people [16]. Evidence from longitudinal studies investigating the relation of different oral health-related aspects with weight loss in older people is however inconclusive [17–22]. Two studies focused on chewing problems [18, 22], but only one found an association with weight loss of >1% in 6 months and >10% in 12 months [18]. Three studies investigated the relation of the number of teeth as well as denture use with weight change [17, 19, 20]. Two of these studies reported an association between edentulism and weight loss [17, 19], while the third showed an association to weight gain [20]. No association between denture use and weight change was found [20]. Three studies examined periodontal problems (e.g., swollen gums or gingival bleeding) [17, 18, 21]. However, only one of these studies reported an association of periodontal diseases with weight loss >5% in 2 years [21], while the others showed no association.

These previous studies had follow-up periods between 6 months and 4 years and all studies used statistical approaches modeling single measures of oral status as independent variable, assessed at baseline, and weight loss during follow-up as outcome, but do not account for change in oral health status over time, which is likely to occur with aging. Longitudinal studies including multiple oral health conditions and investigating if change in oral health goes in parallel with changes in body weight are currently lacking. Combining such information with the results of determinant-related research might be valuable with regard to developing preventive strategies for malnutrition. Therefore, the aim of this study was to investigate the longitudinal associations of multiple oral health conditions with body weight in Dutch community-dwelling older adults over a period of 10 years.

Methods

Study design and study sample

This study was performed within the Longitudinal Aging Study Amsterdam (LASA), an ongoing cohort study with a study population representative for Dutch people aged 55–85 years [23, 24]. The first cohort was established in 1992/93 and the second in 2002/03. Follow-up examinations have been performed with intervals of 3 years and side studies in-between. The examinations comprised general and medical interviews with anthropometric measurements. The study protocol was approved by the Medical Ethics Committee of the VU University Medical Centre Amsterdam and written informed consent was obtained from every participant.

This analysis refers to the LASA wave of 2005/06 and the LASA Lifestyle Side Study in 2007 serving as baseline measurements of body weight and oral health, respectively, and additionally to the follow-up wave in 2015/16, where these assessments were repeated. Inclusion criteria of the Lifestyle Study were an age ≤80 years, having no cognitive impairment according to Mini Mental State Examination (MMSE ≥ 24), and living independently. For this analysis, participants who had died or dropped out during follow-up or with lacking information on body weight or all oral health variables were excluded. The final study sample comprised $n = 657$ participants. The selection of participants is presented in the flow chart (Fig. 1).

Body weight

The dependent variable of this analysis is body weight, which was measured in participants during the medical interviews to the nearest 0.1 kg using a calibrated bathroom scale (Seca, model 100, Lameris, Utrecht, The Netherlands)

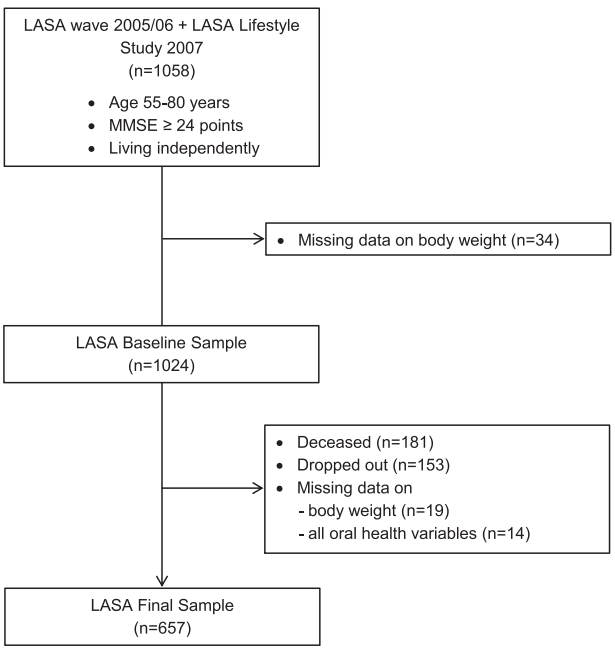

Fig. 1 Flow chart of participants' selection. LASA Longitudinal Aging Study Amsterdam, MMSE Mini Mental State Examination

wearing light indoor clothing. To account for between-subject variations of body weight, squared body height (m^2) was considered. Height was measured to the nearest 0.001 m using a stadiometer during the medical interviews in 2005/06. Body mass index (BMI) was calculated as follows: body weight [kg]/(height [m] × height [m]).

Oral health

Oral health status was assessed by a self-administered questionnaire with predefined answer categories, which has been developed in cooperation with experts on oral health from the Academic Centrum Tandheelkunde Amsterdam and the Netherlands Organization for Applied Scientific Research (TNO). Detailed information on the questionnaire can be found on https://www.lasa-vu.nl/themes/physical/documents/LASA126_varinfo.pdf. For the present analyses, the following variables from the domains teeth/dentures, oral problems, and self-rated oral health status were used. The number of teeth and molars was assessed for the upper and the lower jaw (none, 1–7 teeth, and >7 teeth). The variables were categorized in having no teeth, at least one jaw with 1–7 teeth, or both jaws with >7 teeth. Denture use was also assessed for both jaws separately (none, partial denture, complete denture). These variables were summarized in wearing no dentures, partial dentures, complete dentures, or combined (partial + complete) dentures. For the domain "oral problems," the presence of the following eight oral health-related problems was asked referring to the past 6 months: dental caries, lost/loose or broken teeth, bleeding gums, red or swollen gums, blisters and/or sores in the mouth, dental pain while drinking hot and cold drinks, dental pain while chewing, and xerostomia. In addition, gingivitis was assessed by asking if the dentist or a dental assistant has told the participants within the last 2 years to be affected by gingivitis. The last domain was "self-rated oral health status" assessed by the question "How do you evaluate your oral health (teeth, molars, gums)?" with the answer categories: very healthy (1), healthy (2), not healthy/not unhealthy (3), unhealthy (4), and very unhealthy (5).

Participants' characteristics and potential confounders

As demographic variables age, gender, and level of urbanization were considered. The latter was defined by the mean number of addresses per squared kilometer within a circle with a radius of 1 km, which is matched with the postal codes of the participants' homes. The variable is categorized in not (<500), little (500–1000), somewhat (1000–1500), highly (1500–2500), and very highly (>2500) urbanized. Socio-economic factors are represented by education and income. For education the levels low (elementary education or less), middle (general intermediate, and lower vocational education), and high (university, college, higher vocational, general secondary, and intermediate vocational education) were considered. Net monthly household income was categorized according to the calculated tertiles at baseline and follow-up as low (<1248; <1475 euro/month), middle (1248–1589; 1475–1985 euro/month), or high (>1589; >1985 euro/month). For participants with a partner living in the same household the total household income was multiplied by 0.7 to make it comparable with incomes of single-person households [25]. As social factors marital status (married/registered partnership, never married/divorced, widowed) and living situation (living alone vs. living with others) were included. Smoking status was categorized as never, former, or current smoker.

Health status was described by the number of chronic diseases (based on chronic lung diseases, cardiac disease, peripheral arterial disease, diabetes mellitus, stroke, osteoarthritis and rheumatoid arthritis, cancer, and others) and prescribed drugs. Cognitive status was measured by the MMSE (0–30 points) [26]. Depressive symptoms were evaluated by the Dutch version of the Center for Epidemiologic Studies Depression Scale (0–60 points) [27]. Physical function was assessed by asking for difficulties with seven activities of daily living (ADL: climbing stairs, dressing, rising from a chair, cutting toenails, walking 5 min outside, using public transportation, and bathing) and a composite score was built counting the number of difficulties (0–7).

Statistical analyses

Participants' characteristics and oral health conditions are presented as mean ± standard deviation for continuous variables and as relative frequencies for nominal and ordinal variables for both baseline and follow-up.

Normal distribution of body weight as outcome variable was checked by visual inspection of histograms, P–P plots and Q–Q plots. The longitudinal associations between oral health conditions and the dependent variable body weight were analyzed using linear mixed models accounting for repeated measurements that are clustered within subjects. The type of analysis considers both between-subject differences and within-subject changes. For each oral health condition, a separate model was calculated. Model 1 was adjusted by gender, age, and height^2. Model 2 was additionally adjusted for education, income, level of urbanization, marital status, living situation, smoking, number of medications, MMSE score, CES-D score and ADL limitations and Model 3 for number of chronic diseases. With the exception of gender, height^2, and education, confounders were considered for both baseline and follow-up examinations to account for potential changes over time. Confounders were included taking into

account their significance reported in the literature [7, 28, 29] and based on a priori tests of their influence on the respective associations. The results of both statistical models are presented as regression coefficients (*b*), standard errors (SE), and *p* values. The regression coefficient represents both the within-subject and the between-subject relationships. In addition, potential interaction effects between dental status (teeth/no teeth) and the other oral health factors were tested by adding the interaction term to the univariate models. As none of the associations between oral conditions and body weight were moderated by dental status the results were not presented. Statistical analyses were performed with SPSS Version 24 (IBM SPSS Statistics, Chicago, IL, USA).

Results

Participants' characteristics

Characteristics of the participants at baseline and at 10-year follow-up are presented in Table 1. Baseline age of the participants was 66.4 ± 5.8 years and about half of the sample was female. The levels of urbanization and income increased from baseline to follow-up. The proportions of participants being widowed and living alone also increased, while the proportion of current smokers decreased. With regard to health an increase in the number of chronic diseases and prescribed medications was observed. The changes in mean MMSE and CES-D scores indicate a slight cognitive decline and a slight increase in depressive symptoms. The number of limitations in ADL also increased slightly over time.

Body weight

During the 10-year follow-up mean body weight decreased slightly from 79.1 ± 13.3 to 77.6 ± 13.8 kg (Δ −1.5 ± 5.5 kg, min. −24.0 kg, max. 20.5 kg). Mean BMI was 27.3 ± 3.9 kg/m^2 at baseline and 26.8 ± 4.2 kg/m^2 at follow-up (Δ −0.5 ± 1.9 kg/m^2, min. −8.1 kg/m^2, max. 6.3 kg/m^2).

Oral health

Oral health conditions of the participants at baseline and follow-up are presented in Table 2. The number of teeth decreased over time, while the proportion of participants wearing any type of denture increased. At baseline the oral health problems with the lowest prevalence were dental pain while chewing (5.2%) and lost/loose or broken teeth (5.3%), while xerostomia showed the highest prevalence (24.3%). The prevalence of self-reported dental caries, blisters, and/or sores in the mouth and gingivitis remained relatively stable over time (Δ < 1%). The frequency of suffering from dental pain while chewing increased slightly, while the proportions of participants with lost/loose or broken teeth as well as with xerostomia increased more distinctly (Δ 5%). The prevalence of self-reported bleeding gums, red or swollen gums, dental pain while drinking and gingivitis

Table 1 Characteristics of the LASA study participants at baseline and at 10-year follow-up ($n = 657$)

	Baseline	10-year follow-up
Age [years]	66.4 ± 5.8	76.4 ± 5.8
Female gender [%]	54	54
Level of urbanization [%]		
Not	17.8	10.8
Little	27.4	36.5
Somewhat	20.7	8.4
Highly	19.3	26.9
Very highly	14.8	17.2
Missing	0	0.2
Education [%]		
Low	18.4	18.4
Middle	57.2	57.2
High	24.4	24.4
Income [%]		
Low	29.8	28.5
Middle	45.5	30.6
High	18.3	33
Missing	6.4	7.9
Marital status [%]		
Married/registered partnership	75.2	62.4
Never married/divorced	11.1	11.4
Widowed	13.7	26.2
Living situation [%]		
Living alone	21.3	35
Living with others	78.7	64.2
Residential home	0	0.6
Missing	0	0.2
Smoking [%]		
Never	32.7	32.4
Former	54.3	59.5
Current	12.9	8.1
No. chronic diseases	1.5 ± 1.2	2.1 ± 1.4
No. medications	2.0 ± 2.1	3.8 ± 3.2
Cognitive status		
MMSE score (24–30 points)	28.4 ± 1.4	27.9 ± 2.2
Depressive symptoms		
CES-D score (0–60 points)	6.8 ± 6.3	7.5 ± 6.3
Limitations in 7 ADL (0–7 points)	0.8 ± 1.4	1.5 ± 1.9
Missing [%]	0.5	1.4
Body height [m]	1.70 ± 0.09	1.70 ± 0.09
Body mass index [%]		
<20 kg/m^2	1.1	2.4
20–<25 kg/m^2	28.5	33.2
25–<30 kg/m^2	49.8	45.8
≥30 kg/m^2	20.7	18.6

Mean ± standard deviation

MMSE Mini Mental State Examination, *CES-D* Center for Epidemiologic Studies Depression Scale, *ADL* activities of daily living

Table 2 Frequencies of oral health conditions [%] in LASA participants at baseline and at 10-year follow-up ($n = 657$)

	Baseline	10-year follow-up
Teeth	$n = 635$	$n = 635$
Both jaws > 7 teeth	42.2	33.4
At least one jaw with 1–7 teeth	28.2	32.3
Edentulism	29.6	34.3
Dentures	$n = 631$	$n = 631$
No dentures	44.2	37.7
Partial dentures	16.0	18.5
Complete dentures	32.2	37.1
Combined dentures	7.6	6.7
Oral problems	$n = 579$	$n = 579$
Dental caries	16.4	16.4
Lost, loose broken teeth	5.3	10.0
Bleeding gums	13.4	9.7
Red or swollen gums	9.7	8.8
Blisters and/or sores in the mouth	10.7	11.0
Dental pain while drinking (hot/cold drinks)	10.3	9.0
Dental pain while chewing	5.2	6.6
Xerostomia	24.3	30.0
Gingivitis ($n = 581$)	9.8	9.1
Self-rated oral health status	$n = 541$	$n = 541$
Very healthy	3.3	5.0
Healthy	65.2	66.9
Not healthy/not unhealthy	28.1	23.4
Unhealthy	2.8	3.3
Very unhealthy	0.6	1.3

decreased during the 10-year follow-up. The majority of participants rated their oral status as healthy at both assessments and the mean scale score of self-rated oral health revealed a small increase from baseline (3.68 ± 0.61) to follow-up (3.72 ± 0.67).

Longitudinal association of oral health conditions with body weight

In Table 3, the results on the longitudinal associations of oral health conditions with body weight are presented. Oral health conditions focusing on teeth, dentures, and oral problems did not show longitudinal associations with body weight neither in the model adjusted for age, gender and height^2 (model 1) nor in the model adjusted for additional confounders (model 2 and 3). In contrast, self-rated oral health was associated with body weight ($b = 0.724$, SE = 0.296, $p = 0.015$) after adjusting for various confounders (model 3). The regression coefficient indicates that a one point difference in self-rated oral health status is related with a difference in body weight of 724 g and that a deterioration of one point on the self-rated oral health scale goes along with an decrease in body weight of 724 g within 10 years.

Discussion

This prospective study presented unique multiple oral health data, repeatedly assessed over a period of 10 years in a large sample of community-dwelling older adults and identified a longitudinal association of self-rated oral health status with body weight after controlling for multiple confounders.

Body weight

In our study the mean body weight decreased slightly over time ($\Delta\ -1.5 \pm 5.5$ kg). However, on the individual level several remarkable changes in body weight were observed. A similar mean decrease in body weight was reported in the Health ABC study with older adults without mobility disability at baseline [30]. In clinical populations, a more distinct weight loss over time can be expected [31].

Teeth and dentures

The baseline percentage of edentulous persons in our study was 29.6% and is similar to findings in older people aged 65–74 years from the Netherlands (27.6%) reported in a comparative study of 14 European countries [32]. The percentage within that study ranged from 2.7 to 27.6% and was the lowest in Sweden [32]. During the 10-year follow-up, the number of edentulous participants increased by 5% in our study. The parallel increase of complete denture wearers indicated that the lost teeth were replaced by dentures. This could be a reason for not finding a longitudinal association between edentulism and body weight. It could be speculated that the loss of teeth has more impact on body weight in the short term when the lost teeth are not yet replaced. Tooth loss without replacement might impair oral functioning and consequently dietary intake more severely [10, 11]. A previous study in community-dwelling older adults from Brazil finding an association of edentulism with weight loss > 5% in 4 years reported a high need for dental prostheses [19]. Two further studies from the United States reporting 36 and 21% of the participants being edentulous but mostly wearing dentures reported contradictory results with regard to body weight—one showing an association with 1-year weight loss the other with 1-year weight gain [17, 20]. These controversial results could imply that additional, more functional-related dental aspects such as the fit of dentures or chewing efficacy might be of importance with regard to nutrition. This is supported by results of a large cross-sectional study in community-dwelling older

Table 3 Longitudinal associations of oral health conditions with body weight [kg] during a 10-year follow-up using linear mixed models accounting for repeated measurements that are clustered within subjects

	Model 1			Model 2			Model 3		
	b	SE	*p*	*b*	SE	*p*	*b*	SE	*p*
Teeth ($n = 657$)									
Edentulism	−0.435	0.719	0.546	−0.923	0.731	0.207	−0.895	0.730	0.221
Dentures ($n = 655$)									
No dentures									
Partial dentures	0.331	0.654	0.505	0.315	0.653	0.630	0.338	0.653	0.605
Complete dentures	−0.124	0.747	0.869	−0.739	0.758	0.330	−0.680	0.757	0.369
Combined dentures	−0.141	1.029	0.891	−0.728	1.029	0.479	−0.689	1.028	0.503
Oral Problems ($n = 643$)									
Holes	0.262	0.457	0.566	0.317	0.451	0.483	0.337	0.452	0.457
Lost, loose broken teeth	−0.104	0.594	0.862	0.289	0.592	0.626	0.295	0.592	0.618
Bleeding gums	−0.319	0.547	0.560	−0.447	0.541	0.409	−0.433	0.541	0.424
Red and swollen gums	−0.353	0.598	0.555	−0.241	0.590	0.682	−0.247	0.590	0.676
Blisters and sores in the mouth	0.091	0.589	0.877	0.399	0.585	0.495	0.395	0.584	0.500
Dental pain while drinking	0.749	0.581	0.198	0.657	0.574	0.253	0.627	0.575	0.276
Dental pain while chewing	1.087	0.709	0.126	0.989	0.710	0.164	0.966	0.710	0.174
Dry mouth	−0.324	0.418	0.439	−0.265	0.416	0.524	−0.311	0.418	0.458
Gingivitis ($n = 649$)	0.216	0.618	0.727	0.605	0.612	0.324	0.595	0.613	0.332
Self-rated oral health status ($n = 645$)									
Continuous (very healthy-very unhealthy)	−0.484	0.291	0.096	−0.708	0.295	0.017	−0.724	0.296	**0.015**

Model 1: adjusted for age, gender, and height^2, Model 2: adjusted for age, gender, height^2, education, income, level of urbanization, marital status, living situation, smoking, number of medications, MMSE score, CES-D score, and ADL limitations; Model 3: adjusted for age, gender, height^2, education, income, level of urbanization, marital status, living situation, smoking, number of medications, MMSE score, CES-D score, ADL limitations, and chronic diseases

Bold numbers indicate significant results

people showing that a poor masticatory performance but not the number of teeth or type of dentures was associated with a low BMI [33]. Furthermore, an analysis of five cohorts of older people at the age of 70 reported that despite improvements in dental status during a period of 30 years, comprising a reduction of edentulism as well as an increase of fixed denture wearers, the perceived chewing ability did not change markedly over time [34].

Oral problems

Oral problems were comprehensively assessed by nine items including specific teeth- and gum-related aspects and more general oral problems such as xerostomia. For all these self-reported oral problems no longitudinal association with body weight was found. The gum-related problems, such as red or swollen gums, bleeding gums, or gingivitis, are reversible and might therefore not affect body weight in the long term. Periodontitis was not specifically addressed by our questionnaire, but might have a bigger impact on a person's health and quality of life [35, 36]. The comparison with other longitudinal studies is limited due different operationalizations of oral health problems and due to different statistical approaches, as in all of these studies oral health variables were solely considered at baseline and generally weight loss was defined by a threshold [17, 18, 21]. However, one of these longitudinal studies found an association of objectively measured periodontal disease with weight loss of >5% over a period of 2 years in community-dwelling older adults [21]. The two further studies, one conducted in community-dwelling older adults and one in nursing home residents, reported no relation to weight loss according to objectively and subjectively assessed oral health variables, respectively [17, 18]. In our study for most oral health problems the prevalence was rather low (<5%) with only small changes over time indicating little variance in these data, which may explain the null findings. Investigating oral health problems repeatedly in shorter time intervals, adding a complementary oral investigation and using questions on severity, are aspects to be considered in future research.

Self-rated oral health

In our study oral status was rated as healthy or very healthy by the majority of participants at both assessments while the

proportion of participants with a poor self-rated oral health status increased marginally over time (1.2%). However, self-rated oral health status was the only oral health variable showing a longitudinal association with body weight after adjusting for demographic, socio-economic, health-related, psychological, and functional confounders. The results indicate that a poorer self-rated oral health is related to a lower body weight at baseline and at follow-up and furthermore, that a deterioration of one point on the oral health rating scale goes along with a decrease in body weight by 724 g within 10 years and vice versa. On the first view this decrease in body weight might seem small and therefore not clinically meaningful. Often weight loss of 5–10% in periods of 1–10 years is considered to be relevant with regard to negative outcomes [37]. However, in older people already smaller changes might be meaningful [37]. Weight loss is an important sign of malnutrition [1] and was shown to be associated with poor health outcomes [2, 4] and increased health care costs [38]. Even small annual changes in body weight (e.g., −0.7 to −1.6 kg or ≥−1%) were associated with a 1.7- to 2.2-fold increased mortality risk in older people [4]. Weight loss in older age is often related to multiple causes [39], the decrease in body weight due to poor oral health needs to be considered in addition to the often observed weight loss due to other factors such as diseases, physical functional, or cognitive decline [39–41], aspects that were adjusted for in our analysis. Other longitudinal studies investigating self-rated oral health status in relation to body weight in older people are currently lacking. Compared with other measures of oral health, such as single oral health problems, self-rated oral health may aggregate the perception of different oral health problems and may better reflect if these conditions are serious enough to affect the persons' well-being and dietary intake. As oral health problems are usually modifiable an early identification, possibly supported by simple questions on self-rated oral health, in clinical practice is important. In terms of prevention of poor oral health attention to oral care of older people should be paid.

Strengths and limitations

Using data of a prospective cohort study, considering different oral health aspects, controlling for multiple relevant confounders, and accounting for within subject changes in oral health status, body weight, and confounders are important strengths of this study. However, oral health was assessed by self-reports without performing a complementary oral examination. For conditions such as dental caries this would have been more precise. The information quality of questionnaire items was limited, as predominately yes/no answers were used reflecting neither severity nor duration of the respective problems. In addition, a recall bias cannot be completely ruled out for oral health aspects referring to a specific time period. To minimize this potential source of bias only participants without cognitive impairment at baseline were included. As exposure was not measured before the outcome reverse causation cannot be excluded.

Conclusions

In our study in community-dwelling older adults a poorer self-rated oral health status was associated with lower body weight in the long term. As the simple oral health scale consisting of one single question could be easily integrated in clinical practice it could serve to identify a risk of weight loss and to initiate oral interventions, provided that the reliability and validity can be verified by further investigations. To gain more insight in the longitudinal association between oral health status and body weight, studies with repeated measurements covering both short and long intervals and accounting for the complexity of oral health (e.g., by structural equation modeling) are needed. To prove whether a change in oral health status is causally linked to changes in nutritional status intervention studies are necessary. In addition, to reduce heterogeneity between studies and to better compare study results, efforts to standardize subjective as well as objective oral health assessment are of importance.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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